ME 120 Homework 4

Use the Direct Solution Format for all problems on this assignment. Use a word processor to include the source code for all problems involving programming. The first sheet of solution document should have your name, the assignment number and the date. The first page does not need to be a separate cover sheet. The problem number and name of the Arduino sketch should be clearly labeled for each problem. In other words, *do not just print the source code on otherwise unlabeled sheets of paper*. Print the word-processor file and include it with any other sheets of paper you submit as part of your assignment. Do not email the document to your instructor.

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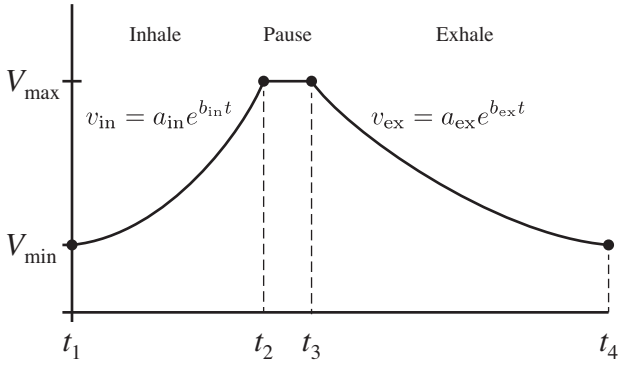
1. (5 points) Choose values of V_{min}, V_{max}, t_2, t_3, and t_4 to define a model of the breathing LED as depicted in the plot to the right (we will set t_1=0).



   a. What are your values of V_{min}, V_{max}, t_2, t_3, and t_4?
   b. For the value of V_{min}, V_{max}, t_2, t_3, and t_4 used in the preceding step, what are the coefficients of the two exponential functions for the inhale phase (a_{in} and b_{in}) and exhale phase (a_{ex} and b_{ex}) of the breathing cycle?
   c. Use Excel to make a plot of the breathing cycle. Your plot should look like the one in the problem statement above.

2. (8 points) Build the breadboard circuit and write an Arduino sketch to implement the breathing LED described in the class notes. Use the parameters and equations obtained in your solution to the preceding problem. Declare the parameters as variables in the header of your program. Have your code running and ready to show your instructor at the start of class on the due date.

   On the solution you turn in for grading, include your program listing in a word-processing document.

Rubric:

- +1 point if all components are there and connected (to be checked by instructor)
- +3 point if it looks like it is breathing (to be checked by instructor)
- +4 points if code is correct (to be checked by TA when grading):
  - > Variables are set in header
  - > If/else statement is used correctly to account for the 3 different phases
  - > Equations for the two exponential phases are correct

3. (7 points) Set up a potentiometer circuit and a servo motor circuit on your breadboard. Hook up your servo to one of the two servo-ready pins (either 9 or 10) on your Arduino. Write a program that sweeps the servo over a range of angles from **`amin`** to **`amax`** in increments of da, and then reverses the sweep from (**`amax`** – **`da`**) to **`amin`** in decrements of **`da`**. Between each step in the sweep, pause for at least 50 milliseconds. The increment **`da`** should be 5 or 10 degrees and **`amin`** should be no less than 10 degrees. Use the potentiometer to set the value of **`amax`**, and constrain the value of **`amax`** to be between 60 and 170 degrees.

   Be prepared to demonstrate your working servo on the day that the homework is due. In other words, you will have to demonstrate both the breathing LED and the servo sweep problem in class.

   On the solution you turn in for grading, include your program listing in a word-processing document.

   Hint: Circuit 8 in the Tinker Kit documentation has some of the pieces to the program that you will need.